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AUTHOR Marsiske, Michael; Willis, Sherry L.
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ABSTRACT

Traditionally, assessment of the cognitive competencies of older adults has focused on abstract laboratory tests, which have often seemed quite unlike the demands of tasks encountered in everyday activities. Consequently, external validity of these laboratory tasks has been questioned, and their utility for assessing real-world competence has been debated. This study examined age-related change in performance on a measure of everyday competence, the ETS Basic Skills Test, a 65-item multiple-choice measure. Subjects were older adults (N=102) who participated in a 7-year follow-up of the Adult Development and Enrichment Program. When change was examined at the intraindividual level, 62 percent of the subjects had scores classified as stable or increased, despite findings of significant mean decline over the 7-year period. Measures of crystallized and fluid intelligences were identified as significant predictors of basic skills performance via multiple regression analyses. The finding of significant intellectual and personal predictors of basic skills performance has two implications for further study of competence in everday activities. First, the findings indicated substantial relationships between traditional, academic forms of intelligence and at least some forms of practical intelligence. Secondly, the findings of the regression analyses suggest that it may be possible to isolate some of the variables predisposing an individual to be "at risk" for incompetence in certain types of everyday tasks. Charts and references are included. (Author/ABL)

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Description and Prediction of Age-related Change in Everyday Task Performance[1]

Michael Marsiske and Sherry L. Willis

S-113 College of Health and Human Development

The Pennsylvania State University

University Park, PA 16802

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Abstract

Age-related change in performance on a measure of everyday competence (ETS Basic Skills) was examined for 102 older adults who were participants in a seven-year follow-up of the Adult Development and Enrichment Project (ADEPT). When change was examined at the intraindividual level, 62% of the sample had scores classified as stable or increased, despite findings of significant mean decline over the 7-year period. Measures of crystallized and fluid intelligences were identified as significant predictors of Basic Skills performance via multiple regression analyses. Discussion focuses on the meaning and nature of these age-related changes in Basic Skills performance.

Predicting Real-Life Task Performance Change in the Elderly

Introduction

Traditionally, assessment of the cognitive competencies of older adults has focused on abstract laboratory tests, which have often seemed quite unlike the demands of tasks encountered in everyday activities. Consequently, external validity of these laboratory tasks has been questioned, and their utility for assessing real-world competence has been debated. (McClelland, 1973; Schaie, 1978).

In response to the questionable ecological validity of traditional intellectual assessment techniques, there has been a growing number of studies examining a variety of forms of practical intelligence, including "everyday" tasks (Cavanaugh, Kramer, Sinnott, Camp, & Markley, 1985; Cornelius, Kenney, & Caspi, in press), "indigenous" tests (Demming & Pressey, 1957), "practical intelligence" (Willis & Schaie, 1986), "practical problem solving" (Camp, Doherty, Moody-Thomas, & Denney, in press), and "pragmatics of intelligence" (Dixon & Baltes, 1986) have appeared. As this diversity of terminology may indicate, a considerable array of approaches to the study of everyday

intellectual performance exists. Discerning common themes that emerge despite this multiplicity of research paradigms has not been easy. In addition, there has been a dearth of longitudinal studies examining changes in everyday competence; consequently, no clear statements about age changes in the performance of this wide array of practical, everyday tasks can be made.

Little is known about the specific abilities and processes underlying everyday competence. Is decline to be understood as the product of biological and/or social losses? Is any observed stability to be seen as the compensatory reorganization of the cognitive structures underlying everyday competence? (see Dixon and Baltes, 1986). In other words, the predictors of practical task performance also need to be examined, to provide insight into the mechanisms of change in practical intelligence. Willis & Schaie (1986) have suggested that psychometric abilites are one important source of variance underlying performance on some types of everyday tasks. Changes in real-life task performance are therefore seen as reflecting underlying changes in cognitive ability.

The psychometric approach to the study of practical intelligence has much to recommend it. There already exists a large literature on intellectual development (many studies using longtitudinal designs), with considerable data in which to examine developmental trends (Schaie, 1988). In addition, previous research examining age differences in primary mental

ability structure has suggested that the latent structural pattern of intelligence is stable across a broad age range (Hertzog & Schaie, 1986; Schaie, Willis, Hertzog, & Schulenberg, 1987; Willis, Note 1). This suggests that a psychometric model of intelligence is as relevant to older age groups as it is to younger age groups. Most importantly, a growing body of data exists which supports the existence of a relationship between psychometric abilities, and real life problem situation simulations and real-life tasks. Camp, et al (in press), Cornelius & Caspi (1987), Cornelius, Kenny & Caspi (in press) Hayslip & Sterns (1979), Shroth (1983), and Willis (Note 1) have all found significant relationships between various practical problem solving measures and everyday task simulations, and measures of fluid and crystallized abilities.

The present study examined age changes in everyday intellectual functioning. Age-related change in performance on a real-life task measure (the ETS Basic Skills test) was examined in an elderly sample. The test was part of a broad ability battery which was first administered in 1979, and which was again administered in 1986.

Existing psychometric intelligence research has suggested that there are wide individual differences in the rates and patterns of cognitive aging (e.g., Schaie, 198-). In the present study, a psychometric abilities approach to the study of practical intelligence was used. Tests of primary mental abilities were adminstered at both occasions, and their

relationship (as predictors of performance on the Basic Skills test) to real-life task functioning was assessed. Thus, the present study examined the following questions: 1) What is the pattern of age-related change on a test of "everyday intelligence" ? 2) What are the correlates and predictors of such changes, with a special focus on primary mental ability predictors? 3) Are various everyday tasks characterized by different longitudinal patterns.

Method

Sample

The sample was composed of 102 community-dwelling Caucasian Pennsylvania elderly (16M, 86F) ranging in age from 69-93 years (M=76.9 S.D.=5.74) at the 1986 measurement occasion. Subjects were participants in a 7-year follow-up of the Adult Development and Enrichment Project (ADEPT). Educational level ranged from 6-22 (M=12.08, S.D.=3.22) years. Mean annual income reported ranged from $6000-$16000. Self-reported health ranged from 1 (very good) to 5 (poor) (M=2.07, S.D.=0.86).

Subjects were paid for their participation at a rate of $5.00 per hour. Participation involved a 5-hour testing battery, plus take-home questionnaires.

Measures

Ability battery. The psychometric ability battery included multiple marker tests of seven primary mental abilities, representing the Horn & Cattell (1966) theory of fluid (Gf) and crystallized (Gc) intelligences. The seven primary mental abilities represented were: Figural Relations (CFR), Inductive Reasoning (I), Semantic Relations (CMR), Verbal Comprehension (V), Social/Experiential Evaluations (EMS), Memory Span (Ms), and Perceptual Speed (Ps). Table 1 shows the marker tests for each ability

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Insert Table 1 about here

ETS Basic Skills. The ETS Basic Skills Test, a 65-item multiple-choice measure, was used to assess everyday competence. Also included in the test battery was an extensive personal data questionnaire, which provided information on age, marital status, activities, and self-reported health assessments.

Procedure

In 1979 and 1986 subjects were assessed on the ADEPT battery. The 5-hour testing battery was broken down into two two-and-one-half hour sessions, with rest breaks included in each section. Tests were administered to small groups of subjects (n=4-8). A tester and a proctor supervised each testing session.

Derivation of scores

Standardization of data First occasion (1979) test data for each measure were standardized to a mean of 50, and a standard deviation of 10. Second occasion (1986) data for each measure were scaled using 1979 scores for the total sample as a base. This facilitated comparison of the magnitude of age-related change across measures.

Classification of subjects. Subjects' 1986 scores on each ability test and on the ETS Basic Skills test were classified as having declined, remained stable, or increased. 1986 scores that were more than one standard error of measurement below the first occasion score on the same test were classified as having declined. When the second occasion score was greater than one standard error of measurement above a first occasion score, subjects' performance was judged to have increased. 1986 scores that fell within one standard error of measurement of the first occasion score were classed as stable.

Derivation of ETS Basic Skills subscale scores In previous exploratory and confirmatory item factor analyses (Willis, 1987) on Basic Skills items, a general factor (on which all items loaded), and six item factors were identified. The six item factors were labelled: Correspondence, Charts and Forms, Inferential text, Labels, Literal text, and Technical Documents. Scores for each of these task clusters were computed. The scores represented the number of items correctly completed within each cluster. These subscale scores were standardized to a mean of 50, and standard deviation of 10 for Time One (1979) data. Second occasion (1986) scores were scaled, using Time One scores as a base.

These item cluster scores could only be computed for a subset of 45 subjects for whom complete item data across occasions was available. All analyses on ETS factor scores thus involved only 45 subjects. This sample subset (N=45) did not differ significantly from the remaining 57 subjects on most demographic or cognitive variables. There were two exceptions. The sample subset (n=45) was significantly better on the ability test of Visual Memory Span in 1979: $t(100) = -2.99$, $p<.004$; this subset also exhibited significantly better performance on the Number Comparison test in 1979: $t(100) = -2.34$, $p<.02$.

Results

Longitudinal stability of Basic Skills performance

Age-related change in ETS scores was examined at two levels: 1) Change in mean level of performance, and 2) the proportion of subjects whose Basic Skills scores were classified as having increased, remained stable, or declined from 1979 to 1986. Figure 1 shows the proportion of subjects whose Basic Skills performance exhibited reliable decline, increase, or stability from 1979 to 1986. Mean performance on the Basic Skills test at the second occasion of measurement (1986) was significantly lower than in 1979 ($t(101) = -6.09$, $p < .0001$). The mean score at Time 2 was 0.3 of a standard deviation below that of the first occasion. Five percent of the sample was judged as increased, 57% was classified as stable, and 38% were judged as declined.

Insert Figure 1 about here

Longitudinal Stability of Basic Skills subscale performance

Table 2 shows the mean t-scores for the Basic Skills total score and six item cluster scores. Data on each item cluster score are for 45 subjects.

Place Table 2 about here

Few of the item cluster scores showed significant mean change from 1979 to 1986, except for the Literal and Inferential clusters, which showed decline (Table 2).

The proportion of subjects whose Basic Skills scores were classified as having remained stable, increased, or declined, for the total test score, and for each item cluster score, was determined. These proportions are displayed in Table 3.

Place Table 3 about here

Correlates and predictors of Basic Skills scores

Time one correlates of time one Basic Skills performance. The correlations of demographic variables and mental ability scores with the ETS Basic Skills total test scores in 1979 were

examined. The following variables correlated significantly with Basic Skills performance: Culture Fair score (r = .85, p < .0001), Verbal Meaning score (r = .82, p < .0001), ADEPT Induction score (r = .78, p < .0001), Social Translations score (r = .59, p < .0001), Word Matrix score (r = .53, p < .0001), Education (r = .60, p < .0001), Number Comparison score (r = .51, p < .0001), and Auditory Memory Span score (r = .21, p < .04). Age was negatively correlated with performance (r = -.27, p < .007).

Stepwise multiple regression analysis examined the significant ability and demographic correlates of Basic Skills performance in 1979. The independent variables in the resultant model are (partial r^2 in parentheses): Culture Fair score (r^2 = .72), Verbal Meaning score (r^2 = .12), and Education (r^2 = .002). The model's r^2 = .84, p < .0001.

Time two correlates of time two Basic Skills performance. The correlations of ability scores and demographic variables with Basic Skills performance at Time 2 were also examined. The following variables were significantly correlated with Basic Skills scores in 1986. Culture Fair score (r = .82, p < .0001), Verbal Meaning score (r = .82, p < .0001), ADEPT Induction score (r = .70, p < .0001), Social Translations score (r = .69, p < .0001), Number Comparison score (r = .62, p < .0001), Word Matrix score (r = .60, p < .0001), Auditory Memory Span score (r = .53, p < .0001), Education, (r = .52, p <

.0001), and Age (r = -.44, p < .0001).

In stepwise multiple regression analysis the following significant correlates of 1986 Basic Skills performance were identified: Culture Fair score (r^2 = .67), Verbal Meaning score (r^2 = .14), Social Translations score (r^2 = . 01), ADEPT Induction score (r^2 = .003). The model's r^2 = .83, (p = .0001).

First occasion predictors of Basic Skills score at Time Two

The following 1979 ability scores and demographic variables showed a significant correlation with 1986 Basic Skills performance: ETS Basic Skills score (Time 1) (r = .82, p < .0001), Culture Fair score (r = .73, p < .0001), ADEPT Induction score (r = .73, p < .0001), Verbal Meaning score (r = .69, p < .0001), Social Translations score (r = .53, p < .0001), Education (r = .52, p < .0001), Word Matrix score (r = .48, p < .0001), Age (r = -.44, p < .0001), Number Comparison score (r = .41, p < .0001), and Income (r = .19, p < .05).

In stepwise multiple regression analysis the following significant time one predictors were identified: Culture Fair score (r^2 = .56), Verbal meaning score, (r^2 = .06), and ADEPT Induction score (r^2 = .02). The model's r^2 = .64, p < .0001. Table 4 summarizes these multiple regression analyses.

Insert Table 4 about here

Discussion

When performance on the Basic Skills test is used as a proxy for competence in various everyday activities, 7-year longitudinal data indicate a high proportion of stable performers. While mean performance level on the Basic Skills does decline significantly, 60% of subjects were found to show no reliable decline.

The finding of significant intellectual and personal predictors of Basic Skills performance has two implications for futher study of competence in everyday activities. First, the findings indicate substantial relationships between traditional, academic forms of intelligence and at least some forms of practical intelligence. Secondly, the findings of the regression analyses suggest it may be possible to isolate some of the variables predisposing an individual to be "at risk" for incompetence in certain types of everyday tasks. An important

implication follows: Change in everyday competence may reflect change in the underlying supportive cognitive structures.

The patterns of stability and decline on the item clusters of the Basic Skills test are not markedly different from that observed for the total test score. While there is some variation from cluster to cluster, there is not compelling evidence that the stability observed in the total test score reflects some form of compensation. For example, dramatic increase in some task clusters is not matched with declines in other task clusters. Thus, whatever pattern of change is found for the Basic Skills test, it seems to occur uniformly across all of the task clusters which comprise the test.

Reference Notes

1. Willis, S. L. (1987) The relationship between mental abilities and real-life tasks in adolescence and old age. Unpublished manuscript.
2. Willis, S. L. (1984) Grant proposal submission to the National Institute on Aging.

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Table 1
Characteristics of the ADEPT Psychometric Ability Battery

General Dimension	Primary Ability	Test	Rel*	Source
Gf	CFR	Culture Fair	.93	Cattell & Cattell (1961, 1963)
Gf	CFR	ADEPT Figural Relations	.80	Plemons, et al (1978)
Gf	CFR	Raven's Progressive Matrices	.60	Raven (1962)
Gf	I	Induction Standard Test	.75	Ekstrom et al (1976), Thurstone (1962)
Gf	I	Induction Test	.83	Blieszner, et al (1981)
Gf/Gc	CMR	Verbal Analogies	.65	Guilford (1969a)
Gf/Gc	CMR	Word Matrix	.54	Guilford (1969a)
Gc	V	Vocabulary	.76	Ekstrom et al(1976)
Gc	V	Verbal Meaning	.94	Thurstone (1962)

Table 1 (cont.)

Gc	EMS	Social Translation	.82	O'Sullivan & Guilford (1965)
Ms	Ms	Visual Number Span	.74	Ekstrom et al(1976)
Ms	Ms	Auditory Span Backwards No delay	.90	After Ekstrom et al (1976)
Ms	Ms	Auditory Span Backwards Delay	.70	After Ekstrom et et al (1976)
Ps	Ps	Finding As	.94	Ekstrom et al(1976)
Ps	Ps	Number Comparison	.98	Ekstrom et al(1976)
Ps	Ps	Identical Pictures	.94	Ekstrom et al(1976)

* Odd-even split half-reliability

Table from Willis (Note 2)

Table 2

Mean standard scores on Basic Skills test and subtests

Measure	Occasion 1979	1986	t
Basic Skills total score (n = 102)	53.88	50.72	6.09**
Basic Skills total score (n = 45)	52.67	51.49	-1.64
Basic Skills item cluster scores			
Charts & Forms	51.91	52.49	0.91
Correspondence	52.58	49.27	-3.36*
Inferential	52.47	49.29	-2.80*
Labels	51.44	50.78	-0.78
Literal	52.29	50.82	-1.12
Technical	52.73	52.42	-0.36

* $p < .05$

** $p < .01$

Table 3

Stability on ETS Basic Skills Test and subscales

	1979 to 1986 Basic Skills scores		
Scale	%Increase	% Stable	% Decline
Basic Skills total score (n = 102)	38	5	57
Basic skills total score (n = 45)	9	73	18
Basic Skills item cluster scores			
Charts and Forms	16	82	2
Correspondence	2	62	37
Inferential	4	71	24
Labels	16	67	18
Literal	16	64	20
Technical Documents	9	78	13

Table 4

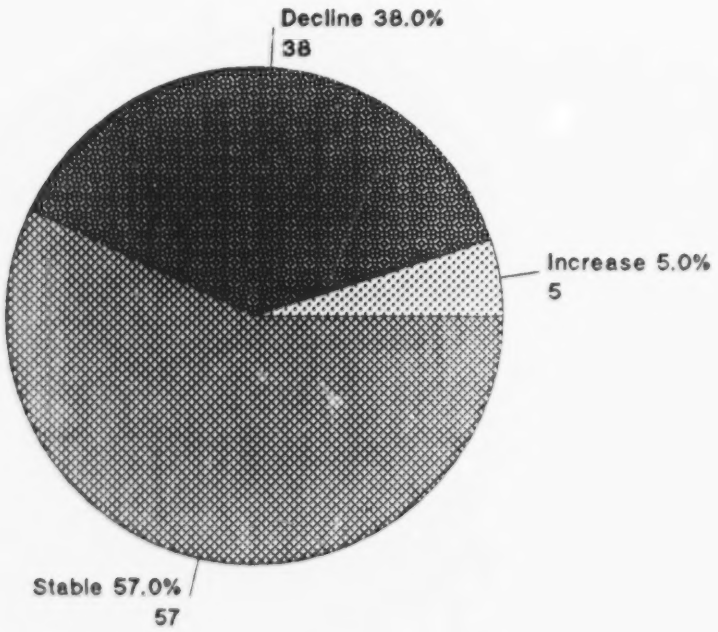
Summary of multiple regression analyses: seven primary abilities, age, education, and income as predictor variables.

Criterion variable	Significant predictors	F	r	Mult r
Basic Skills Total Score (1979)	Culture Fair (1979)	427.08	.72	.84
	Verbal Meaning (1979)	69.77		
Basic Skills Total Score (1986)	Culture Fair (1986)	380.54	.67	.83
	Verbal Meaning (1986)	80.15		
	Social Translations (1986)	7.27		
Basic Skills Total Score (1986)	Culture Fair (1979)	153.26	.56	.64
	Verbal Meaning (1979)	16.96		
	ADEPT Induction (1979)	4.83		

Figure Caption

Figure 1. Basic Skills stability categories: Proportion of subjects with scores classified as stable, increased, or declined.

Basic Skills stability categories: Proportion of subjects
Stable, Increase or Decline



(1979 to 1986)